

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of: Hao et al.

Attorney Docket No.: LAM1P132C1

Application No.: Unassigned

Examiner: Unassigned

Filed: Herewith

Group: Unassigned

Title: LOWER ELECTRODE DESIGN FOR  
HIGHER UNIFORMITY

**CERTIFICATE OF EXPRESS MAILING**

I hereby certify that this paper and the documents and/or fees referred to as attached therein are being deposited with the United States Postal Service on January 3, 2002 in an envelope as "Express Mail Post Office to Addressee" service under 37 CFR §1.10, Mailing Label Number **EL580853587US**, addressed to the Commissioner for Patents, Washington, DC 20231.

Jeena McLeod

*McLeod*

**PRELIMINARY AMENDMENT**

Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

Prior to an examination on the merits, please enter the following amendments:

**In the Specification**

Please amend the specification by inserting before the first line,

**Cross Reference to Related Application**

This application is a continuation of U.S. Patent Application No.: 09/475,824 which was filed on December 30, 1999, and which is herein incorporated by reference.

**In the Claims**

Please **CANCEL** claims 1-21.

Please **ADD** the following claims:

22. A pedestal for supporting a substrate during plasma processing, said pedestal comprising:  
an electrode configured for generating an electric field;  
a chuck disposed above said electrode, said chuck being configured for holding said substrate;

an edge ring disposed above said electrode, said edge ring being configured for shielding said electrode and said chuck; and

an impedance matching layer disposed between said electrode and said edge ring, said impedance matching layer being bonded to said electrode or said edge ring, said impedance matching layer having characteristics or features configured for controlling an impedance between said electrode and a plasma, said impedance being arranged to affect said electric field to improve processing uniformity across the surface of said substrate.

23. The pedestal as recited in claim 22 wherein said impedance is configured to reduce variations in said electric field.

24. The pedestal as recited in claim 22 wherein said impedance is configured to produce variations in said electric field.

25. The pedestal as recited in claim 22 wherein said impedance matching layer is arranged to control said impedance between said electrode and said plasma at the edge of said substrate.

26. The pedestal as recited in claim 22 wherein said edge ring includes a first portion configured to be disposed between said electrode and said substrate when said substrate is held by said chuck.

27. The pedestal as recited in claim 22 wherein said impedance matching layer is configured to be disposed between said electrode and said substrate when said substrate is held by said chuck.

28. The pedestal as recited in claim 22 wherein said first portion cooperates with said chuck to define an area for receiving a bottom surface of said substrate.

29. The pedestal as recited in claim 22 wherein said edge ring has a second portion extending above said first portion, said first portion being configured to surround an outer edge of said chuck, said second portion being configured to surround an outer edge of said substrate when said substrate is held by said chuck for processing whereby said edge ring cooperates with said chuck to form a recessed portion for accepting said substrate for processing.

30. The pedestal as recited in claim 22 wherein said chuck has an outer periphery that is smaller than an outer periphery of said substrate.

31. The pedestal as recited in claim 22 wherein said impedance matching layer is formed from a dielectric material.

32. The pedestal as recited in claim 22 wherein said chuck, edge ring and impedance matching layer are formed from a dielectric material, wherein the dielectric constant of said edge ring is equal to the dielectric constant of said chuck, and wherein the dielectric constant of said impedance matching layer is different than the dielectric constant of said edge ring and said chuck.

33. The pedestal as recited in claim 22 wherein a first impedance produced through said chuck is different than a second impedance produced through said edge ring, and wherein said impedance matching layer is arranged to adjust said second impedance produced through said edge ring so that said second impedance is substantially equal to said first impedance produced through said chuck.

34. A pedestal for supporting a substrate during plasma processing, said pedestal comprising:  
an electrode for generating an electric field between a plasma and said electrode, said electrode having an inner region and an outer region;

a chuck disposed above said inner region of said electrode, said chuck being configured for holding said substrate during processing, said chuck affecting a first impedance between said electrode and said plasma in an area above said inner region of said electrode;

an edge ring disposed above said outer region of said electrode and positioned next to a side of said chuck, said edge ring being configured for shielding at least said electrode from said plasma, said edge ring affecting a second impedance between said electrode and said plasma in an area above said outer region of said electrode;

an impedance matching layer disposed between said edge ring and said electrode and above said outer region of said electrode, said impedance matching layer having characteristics configured to adjust said second impedance so as to improve processing uniformity across the surface of said substrate.

35. The pedestal as recited in claim 34 wherein said chuck is an electrostatic chuck.

36. The pedestal as recited in claim 34 wherein said impedance matching layer is bonded to said edge ring.

37. The pedestal as recited in claim 34 wherein said impedance matching layer is bonded to said electrode.

38. The pedestal as recited in claim 34 wherein the length and position of said impedance matching layer with respect to said edge ring is adjusted to control said second impedance.

39. The pedestal as recited in claim 34 wherein the impedance matching layer is formed from a material with a dielectric constant, wherein said dielectric constant is adjusted to control said second impedance.

40. The pedestal as recited in claim 34 wherein the thickness of said impedance matching layer is adjusted to control said second impedance.

41. The pedestal as recited in claim 34 wherein said electrode has an outer periphery that is greater than or equal to the outer periphery of said substrate when said substrate is disposed on said chuck for processing.

42. The pedestal as recited in claim 34 wherein said electric field produces a uniform sheath voltage at the surface of said substrate when said substrate is disposed on said chuck for processing.

43. The pedestal as recited in claim 34 wherein said electrode is coupled to an RF power source configured to supply RF energy to said electrode.

44. The pedestal as recited in claim 34 further comprising a heat transfer system for controlling the temperature of said substrate and said edge ring during processing, said heat transfer system including a first channel extending through said electrode to the interface between said chuck and said substrate, and a second channel extending through said electrode to the interface between said electrode and said edge ring, said heat transfer system being configured to provide a heat transfer medium through said channels.

45. The pedestal as recited in claim 44 wherein said heat transfer medium is a helium gas.

46. The pedestal as recited in claim 34 wherein said impedance matching layer is configured to match the impedance between said electrode and said plasma at the edge of said substrate with the impedance between said electrode and said plasma at the center of said substrate.

47. The pedestal as recited in claim 34 wherein said inner region of said electrode corresponds to an inner portion of said substrate when said substrate is disposed over said chuck for processing, and wherein said outer region of said electrode corresponds to an outer portion of said substrate when said substrate is disposed over said chuck for processing.

48. A uniformity pedestal for supporting a substrate during processing thereof, said uniformity pedestal comprising:

a first zone configured to be disposed below a first region of the substrate, the first zone having a first impedance when energy is coupled therethrough;

a second zone configured to be disposed below a second region of the substrate, the second zone having a second impedance when energy is coupled therethrough, the second impedance being different than the first impedance; and

an impedance matching layer configured to adjust the second impedance such that the second impedance is substantially equal to the first impedance.

49. A uniformity mechanism suitable for use in a process chamber within which a plasma is ignited and sustained for processing a substrate, the uniformity mechanism comprising:  
a first component that produces a first impedance when energy is coupled therethrough;  
a second component that produces a second impedance when energy is coupled therethrough, the first impedance being different than the second impedance; and  
an impedance matching layer having characteristics configured to adjust the second impedance such that the second impedance is substantially equal to the first impedance, said characteristics including at least one of a thickness, a length, a position, or a material property.
50. The uniformity mechanism as recited in claim 49 wherein the first component is disposed below an inner region of the substrate and wherein the second component disposed below an outer region of the substrate when the substrate is positioned inside the process chamber for processing.
51. The uniformity mechanism as recited in claim 49 wherein the impedance matching layer is disposed below said second component.
52. The uniformity mechanism as recited in claim 49 wherein the uniformity mechanism is configured for supporting the substrate during processing.
53. The uniformity mechanism as recited in claim 49 wherein the first component is a chuck and wherein the second component is an edge ring.
54. The uniformity mechanism as recited in claim 49 further including a third component for generating an electric field.
55. The uniformity mechanism as recited in claim 49 wherein the first and second components are disposed above an electrode.
56. An impedance matching mechanism for use in a process chamber, the impedance matching mechanism being configured to affect an impedance inside the process chamber so as to control an electric field formed inside the process chamber.

57. The mechanism as recited in claim 56 wherein the impedance matching mechanism is contained within a pedestal for supporting a substrate inside the process chamber.

58. The mechanism as recited in claim 56 wherein the impedance is controlled to reduce variations in the electric field.

59. The mechanism as recited in claim 56 wherein the impedance is controlled to produce variations in the electric field.

**REMARKS**

Applicant believes that all pending claims are allowable and respectfully requests a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below.

Respectfully submitted,  
BEYER WEAVER & THOMAS, LLP



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Jeena McLeod

*McLeod*

**Separate Letter to the Official Draftsman**

Commissioner for Patents  
Box: Issue Fee  
Washington, D.C. 20231

Dear Sir:

Enclosed are the formal drawings for the above-identified patent application. If the Draftsman has any question concerning the drawings, he or she is respectfully requested to contact the undersigned.

Respectfully submitted,  
BEYER WEAVER & THOMAS, LLP

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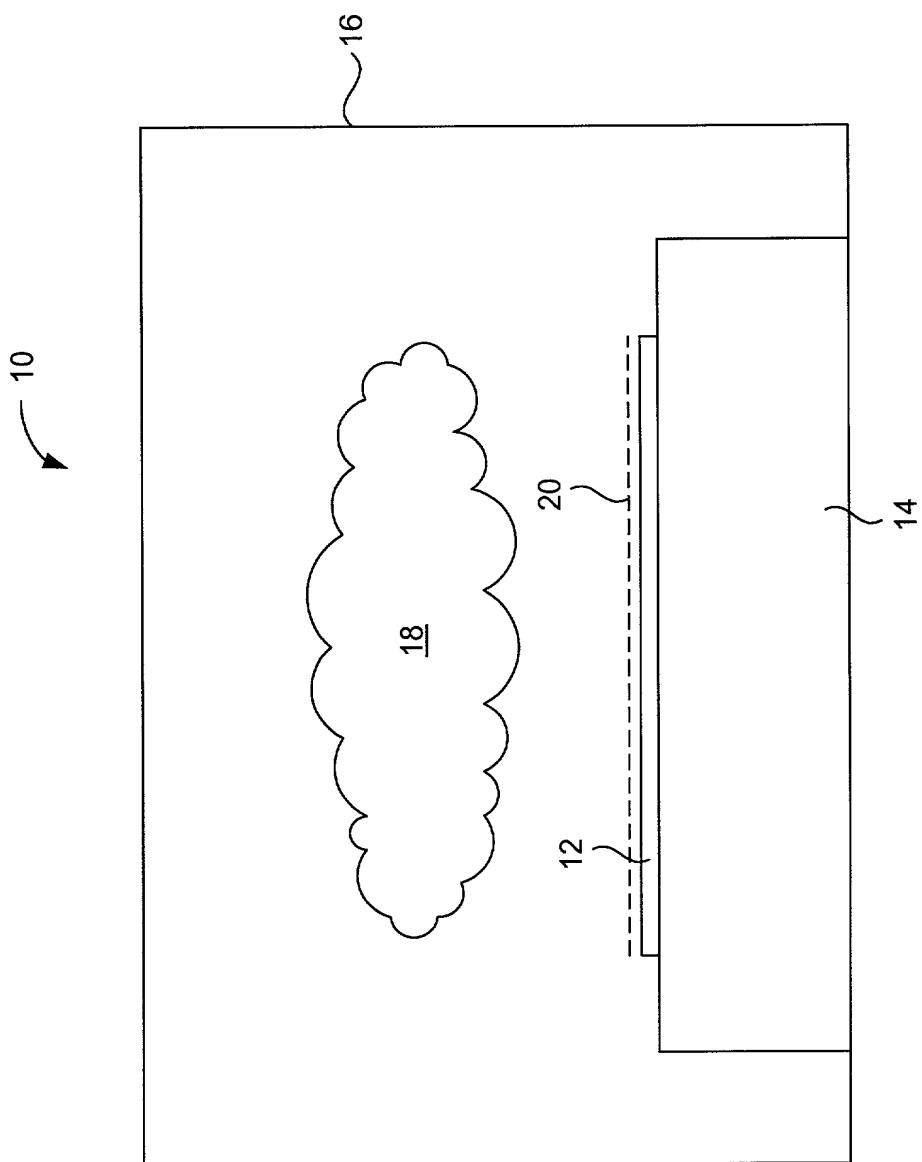


FIG. 1  
(PRIOR ART)

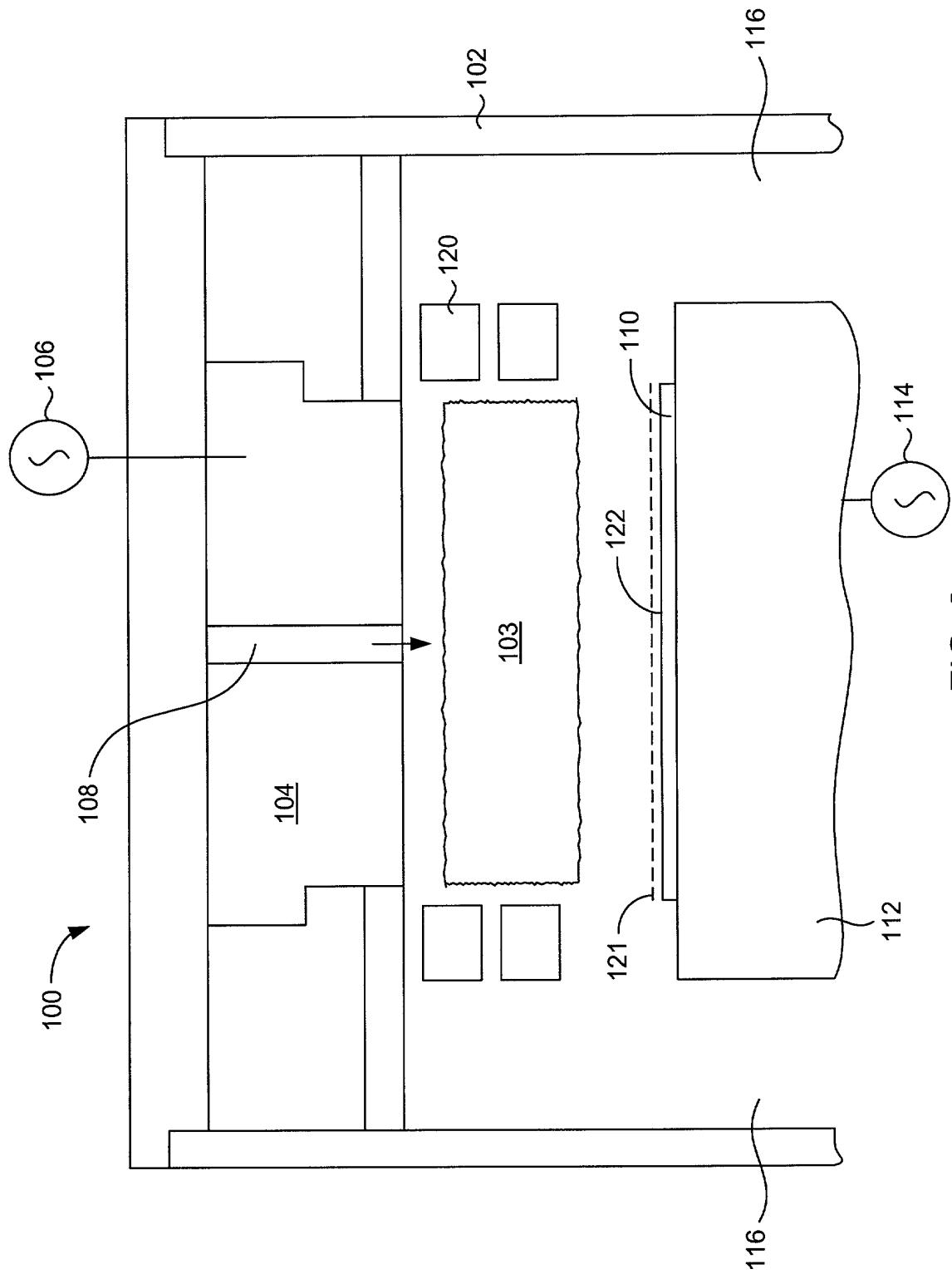
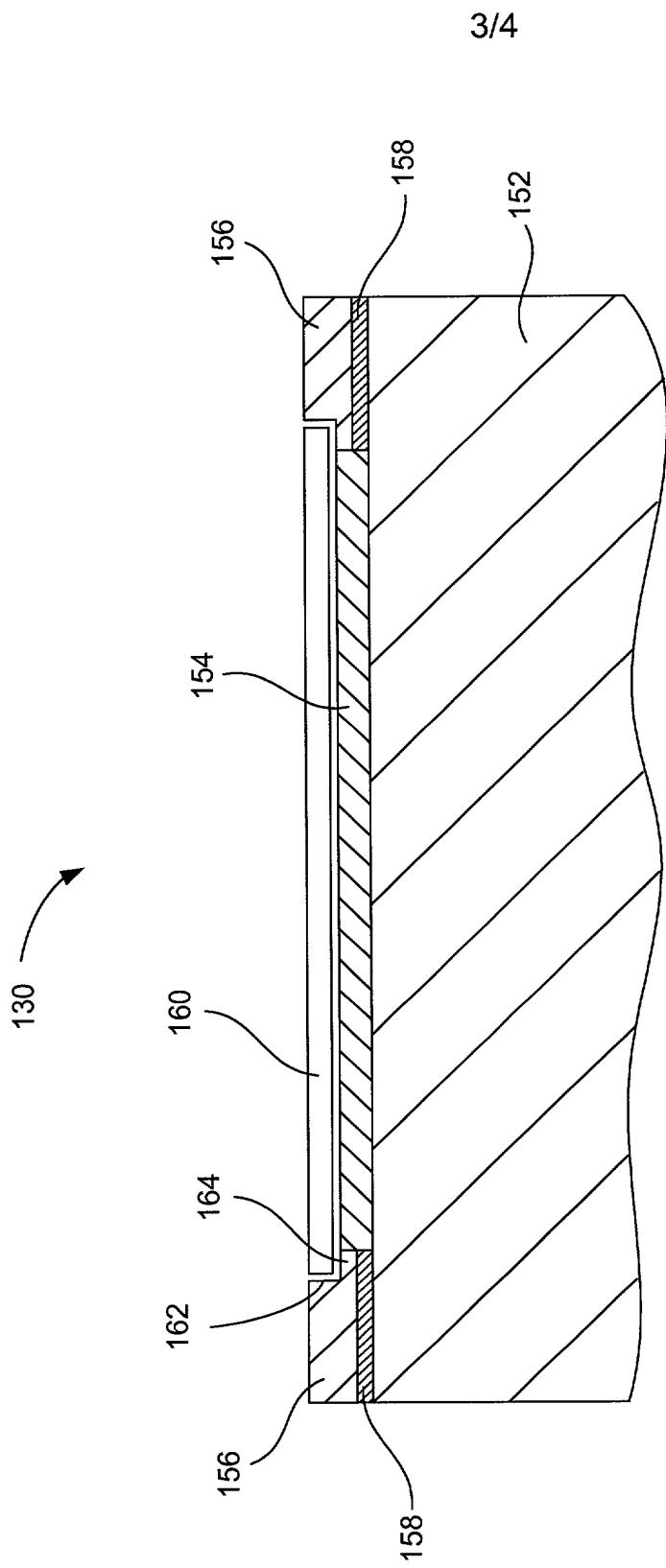


FIG. 2

FIG. 3



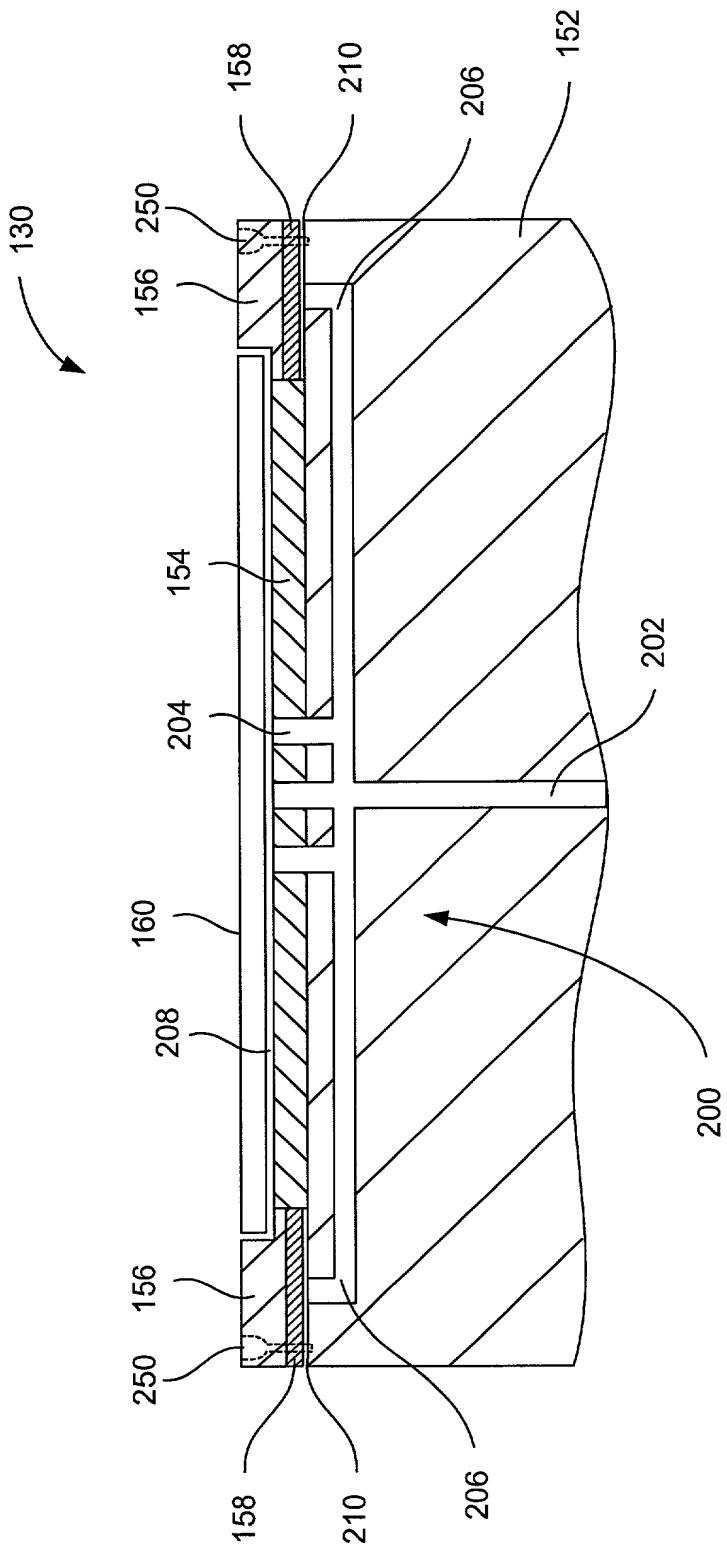


FIG. 4